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DUSTING OF CABBAGE AND COLLARDS TO CONTROL WORMS

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DUSTING OF CABBAGE AND COLLARDS TO CONTROL WORMS

By R. W. Leiby and S. C. Clapp

In this State the several kinds of worms which attack cabbage and collards* are responsible for greater injury in the aggregate than any other pest of these plants. In the western part of the State it is not unusual to see many fields of cabbage in which every plant shows injury by worms to some extent. The cabbage grower sells only the head of the plant, and the consumer sees little, therefore, of the actual loss. At harvest, however, the grower is frequently forced to discard numerous incompletely headed plants. Such plants fail to head properly not only because of the direct feeding of the worms upon the outer leaves, but also because such plants are damaged through loss of sap, and the drying out of the heads and stems that are occasionally eaten into. In this connection we have observed that cabbages will outgrow limited injury by worms in a favorable (usually wet) season, whereas in a rather dry season the continued feeding of the worms, together with the slow growth of the plant, will often stunt it, and the plant will fail to head or head only partially. In any event the feeding of the worms is a detrimental factor to the growing of good cabbage.

In the eastern part of the State, where early spring cabbage is commonly grown, the injury by worms at this time is not so serious. In the eastern part of the State, however, collards are grown in late summer and early fall; and their leaves are often riddled by worms, to the extent that plants will be matured only in a very favorable growing season without some treatment for worms.

It should be understood that there are at least five different kinds of worms that feed upon cabbage and collards in this State, but all of them are the larvæ (or caterpillar stage) of moths or butterflies. The two commonest and most destructive kinds of worms are the Cabbage Looper (*Autographa brassicæ* Riley), and the Imported Cabbage worm (*Pontia rapæ* Linn).

This circular is prepared to enable cabbage and collard growers to distinguish the kinds of worms which are responsible for most of the injury to these plants, and to control their injuries by dusting with a mixture of one pound of dry powdered lead-arsenate and six pounds of dry powdered (air-slaked) lime. The control measures here recommended are based upon six extensive experiments conducted on cabbage and collards in this State, at Raleigh, and the branch experiment station at Swannanoa, during the years 1917 to 1920, inclusive.

THE CABBAGE LOOPER

The cabbage looper is principally a pest on cabbage and collards, although it feeds upon kale, turnip, lettuce and celery. The looping habit of this worm and the arched position of its body on the leaf, readily distinguish it from the imported cabbage worm, which lies flat upon and close to the leaf. The cabbage looper is found very commonly, in fact nearly always, on the under side of the cabbage leaf; while the imported cabbage worm is found usually on the upper side of the leaf.

* For the benefit of readers in the western part of the State and others, it may be said that the "collard" is a cabbage-like vegetable with rather long stem, which does not form a head. By many it is preferred to the cabbage. It is more especially a fall and winter vegetable. It is grown for home use throughout the warmer part of the State and corresponding parts of other Southern states.

This insect passes the winter in the pupa or resting stage in a flimsy sil cocoon. The very small rounded white eggs are deposited by the moths spring on both sides of the leaves, but more frequently on the upper s The eggs hatch in six to nine days; in the fall the egg stage covers a per of seven or eight days. The young larvæ or worms that hatch from the e are at first pale green in color, but as they become grown, the larvæ marked with longitudinal white stripes. The full grown worm measu 1¼ to 1½ inches in length. About 26 days are required for the larva become fully grown.

Fig. 1. Dusting cabbage with a hand dust-gun. Swannanoa, 1918.

After the worm is grown it spins a flimsy cocoon of white silk in which changes to the pupa stage. This pupa is first pale green in color, but development proceeds, and just before the moth emerges from it, the cocoo is dark brown or blackish, and it can be readily seen through the flims cocoon. The cocoon is spun upon the upper or underside of the leaf, b usually in a more or less secluded place. The pupal stage covers abo twelve days in fall, and less time in summer.

The moths are dark gray to black in general color, and have two prom nent silver spots (one of which is U-shaped), located close to each other in contact, near the center of each forewing. The moths are good fliers, a

hey are very active during the late afternoon and early evening, when they ay be commonly collected on Zinnia flowers from which they gather nectar. Vith the nectar of Zinnia flowers as food, we have kept the moths alive in utdoor cages for two weeks, during which time we have observed that the emales will deposit from 150 to 200 eggs.

The larva of this insect is not often killed by insect parasites, but a disase frequently spreads among the larvæ in fall and kills great numbers of hem. Diseased larvæ become inactive, turn a sickly yellowish color, and oon die. After death the skin of the diseased black larvæ breaks open nd the black content smears out over the leaves.

We have found that in late fall this insect requires from five to seven veeks to develop from the egg, through the larva and pupal stages, to the noth stage. This period is considerably shortened in summer, however, nd there are probably at least four generations each year.

THE IMPORTED CABBAGE WORM

A fully grown imported cabbage worm is velvety green in color and marked vith a greenish yellow stripe down the back, and a more or less broken one n each side. It measures about an inch in length. The larvæ of this pecies are frequently found somewhat deep within the cabbage head, at its ase, where they are difficult to poison. They regularly lie flat on the surace of the leaf.

This insect passes the winter as a pupa or chrysalis, but the chrysalis is ot encased in a silken cocoon like that of the cabbage looper. The adult of he imported cabbage worm is a white butterfly—the small white butterflies seen flitting about commonly over cabbage and collard plants during the summer, are almost invariably the parent forms of the imported cabbage worm. These butterflies lay orange-colored eggs on the underside of cabbage or collard leaves. The young worms, upon hatching from the eggs, first skeletonize the leaves, but as they become grown, all of the leaf except the larger veins, are often eaten. When the worm is fully grown it seeks a secluded place, usually on the plant, where it spins a layer of silk over the place selected, and prepares to change to the pupa or chrysalis stage. After spinning the layer of silk over the chosen place, the worm spins a silken cord over the front part of the body, which serves to fasten it securely to the place of pupation. The skin of the worm is then shed and the chrysalis appears; the insect being still securely held in place by the previously spun silken cord. In a week or ten days after pupation the butterfly emerges from the chrysalis. There are five or six generations of this insect developed each year.

CONTROL OF CABBAGE AND COLLARD WORMS

The experiments in the control of cabbage worms, upon which we base the recommendations in this circular, were carried out in 1917 and 1918 on cabbage and collards at Raleigh, and in the years 1917 to 1920 on cabbage at Swannanoa. At Raleigh, in 1917 and 1918, four plats each of cabbage and collards were selected. One plat was dusted weekly with a mixture of one part arsenate of lead and six parts of lime; one plat was dusted every two weeks with this same mixture; one plat had the worms removed by handpicking; and the fourth plat was left untreated to serve as a check.

In 1917, 1918, and 1919, this work was duplicated on late cabbage at Swannanoa, except that an additional plat was dusted every three weeks. The cabbage grown was a standard variety that was planted in July and harvested in October. In 1920 the investigations were modified to the extent that the dusting was done at intervals of ten days only, and during the

time that the worms were numerous; but the dusting was done on sixte different varieties of cabbage. These experiments have led to the followi conclusions.

The material to use.—We have found that one pound of dry powdered l arsenate mixed *thoroughly* with six pounds of powdered (air-slaked) l will poison the worms quickly—the older ones in two or three days, younger ones as soon as they feed a little on the plants. The more rec insecticide, calcium arsenate, when mixed with lime in the same proporti would probably be even more effective, although this insecticide was used in our experiments.

When and how often to apply the mixture.—It seems best that the dust applied when the plants are moist, for the reason that the dust adhe better. This can be done early in the morning when there is dew on plants or immediately after a shower.

Fig. 2. Undusted cabbage plants showing severe injury caused by the feeding of cabb worms. Swannanoa, 1918.

The first application is necessary on cabbages before they begin to he and on collards when eight to a dozen leaves are unfolded; for at this ti worms are nearly always present, at least on the late cabbage. Since t dust is readily washed off the leaves, and since the adults of the worms a continually depositing eggs throughout the growing season (at least in l summer), it is necessary to repeat the application every ten days. Wh the cabbages are partly headed and the collards well grown, the injuries the worms are not so serious, since the plants, if properly cultivated a fertilized, will outgrow, to a limited extent, the feeding of the worms. have observed that this occurs particularly in a favorable growing seas when there is sufficient rainfall. At such times, and under such conditio the grower can afford to omit an application of dust, but then only, when has applied the dust regularly two or three times while the plants we young. We find, however, that four to five applications are advisable d ing the season on late cabbage, as it is grown in the western part of t State, the first application being made about August 1st and the last so time in late September. In general, the dusting should be done every t days for a month shortly after the cabbage is planted, when one or t applications may, sometimes, be omitted (that is, in a favorable growi season) and then one or two subsequent applications made. To secure go control of the worms the grower must adhere to a regular schedule dusting, and he should regularly and carefully examine the plants to asc tain whether the worms are numerous.

Handpicking the worms in the case of large plantings of cabbage and llards, according to our records, is not profitable, although this is at esent the common control method practiced by farmers on garden plantings. ndpicking is laborious and apt to be carelessly done by the average farm oret.

How to apply the dust.—The mixture is best applied by using a hand st-gun. The type shown in Fig. 1 is not as satisfactory as the fan-geared nd duster, which is strapped to the body and operated by a hand crank, d which is now commonly used in dusting cotton and tobacco. A good pe of hand duster can be procured for about twelve to sixteen dollars. The thod of applying the dust by means of shaking it through a sack is not tisfactory, because the dust cannot be directed to the base of the plant, ere the worms, especially the large destructive ones, are feeding.

Fig. 3. Dusted cabbage plants. The plat in which this photograph was taken was jacent to the undusted plat, a part of which is shown in Figure 2. Swannanoa, 1918.

From 18 to 20 pounds of the mixture are necessary for a single application the dust on an acre of well-grown cabbage. Only one-seventh of this mixre is lead arsenate, and, therefore, between two and three pounds of the ison are used per acre for each application.

Is there danger of poisoning in eating cabbage or collards when dusted as commended?—In 1911 a bulletin, entitled "Insect Enemies of Cabbage," as published by the North Carolina Department of Agriculture, in which ofessor Franklin Sherman, its author, advised the dusting of cabbage th a mixture of one ounce of dry paris green and one pound of dry, air-ked lime, to control cabbage worms. This recommendation has been ely followed, and we have yet to hear of any fatal results from the eating cabbage when so dusted. Similar recommendations are made for the con-ol of cabbage worms in other states; nowhere is there a record of any ath caused by eating cabbage that was dusted to control the worms. reover, cabbage treated for worms according to recommendations, has been peatedly analyzed for arsenic within a reasonable time after application of e poison, and the usual finding is only a "trace"; and not enough to poison person under any circumstances. The truth of the matter is, that a good rcentage of cabbage is treated for worms and being constantly consumed the public without ill effects.

It is assumed, of course, that the cabbage grower will exercise ordinary od sense and judgment in dusting his plants. It is never necessary to ver a leaf or plant with a thick coating of the dust. A light, uniform

application, is not only desirable but more effective on the worms. It further assumed that growers will not treat the cabbage just before it is be cut; this is not advised, nor is it necessary. Furthermore, in the case cabbage, the plant grows and heads from the inside, and it is practically possible to apply the dust to the part of the plant usually eaten.

Likewise, there is no danger in eating collards when dusted as her recommended. Our experience shows that over a period of two or th weeks there is not sufficient poison remaining on the leaves under the us growing conditions to poison a cabbage worm; hence we recommend t the applications be made every ten days. It is obvious then that one w consumes a part of a collard will not be poisoned if there is not suffici poison present in the first place to kill a worm.

Finally, we are certainly safe in the conclusion that applications arsenate of lead and lime, as recommended, can be made at any time wh the cabbage and collards are growing, without any injury or danger wh ever to the persons who finally eat the plants. This conclusion is parti larly safe if, in the case of cabbage, the outer rough leaves are discard and if the collard leaves are washed prior to consumption, as is usually d in both cases.